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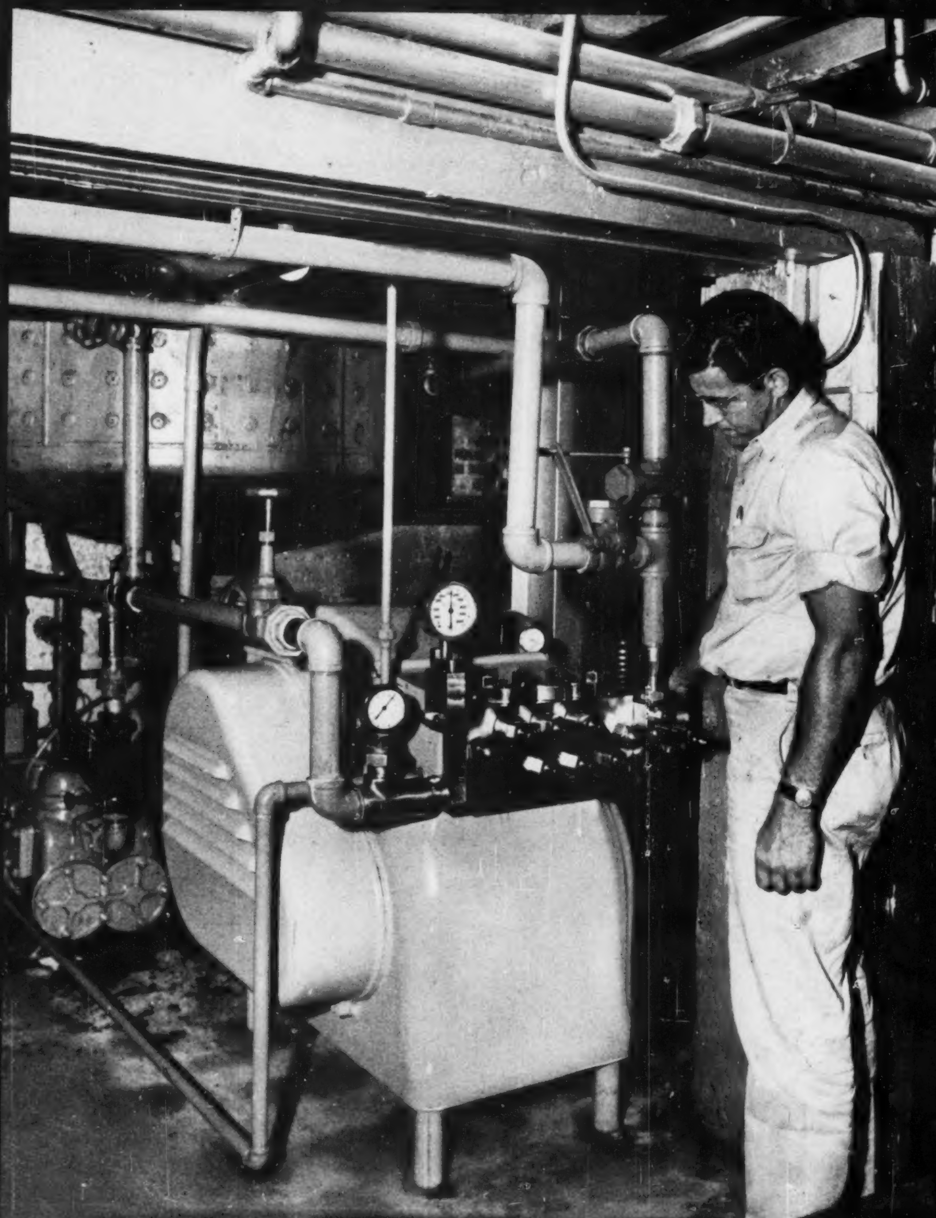

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Published monthly by
The National Lubricating Grease Institute
Harry F. Bennetts, *Editor*
Joanne Couey, *Assistant Editor*
4638 J. C. Nichols Parkway
Kansas City 2, Mo.

1 Year Subscription $2.50
1 Year Subscription (Foreign) $3.25

The INSTITUTE Spokesman

Volume XVI Number 9 December 1952

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ABOUT THE COVER

The supplier of Bentone, the National Lead Company, reports that simplicity is the keynote of compounding greases from this material. This month's cover shows a typical installation at Consumers Cooperative Association at Kansas City, Missouri. The essential equipment is reported to be only a slurrying tank and a milling or dispersing device, in this case a Manton Gaulin Homogenizer.

In the background is seen the slurry tank where the oil, the dry Bentone and any desired additives are mixed. From here the slurry is fed to the homogenizer by means of the low-pressure transfer pump. Within the homogenizer the slurry is passed through the two-stage orifices at 5000 lbs./sq. in. pressure to accomplish the desired dispersion. The discharge is the finished grease, ready to go into the containers.

The homogenizer is a heavy duty, slow speed machine requiring very little maintenance. The device shown is capable of producing 2500 pounds of finished grease per hour. Other models are available having a wide range of production capacity.

The supplier of Bentone reports that consistent product quality is characteristic of this method of grease manufacturing and that the properties of the grease can be easily controlled and duplicated.

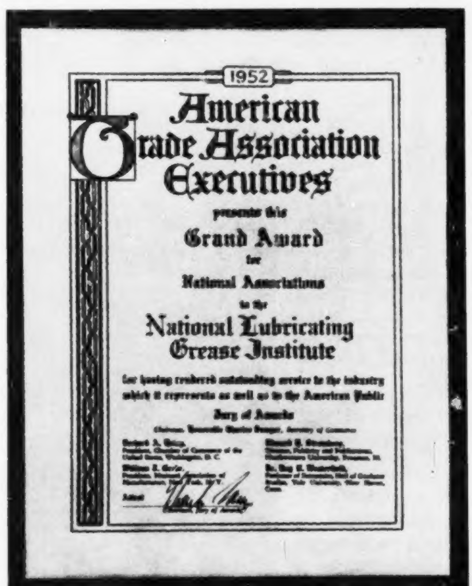
President's page

by W. Wayne Albright, President, N L G I

NLGI WINS HIGHEST AWARD

Your Institute recently received the highest recognition offered a trade association for service to its members and to the public. What two finer reasons can exist for the presentation of an award? The distinguished quality of the membership of the Jury of Awards increases our pride in accepting the honor.

This award is the culmination of the efforts of many, not the least of whom are the NLGI Technical Committee and its several Subcommittees and Panels, and the NLGI Executive Secretary who prepared the presentation submitted to the American Trade Association Executives. Our thanks to all who participated. In the same spirit of gratification, the greetings of the Christmas Season are extended to all NLGI members and friends.



EVAPORATION AND BLEEDING are measured in one series of tests to evaluate high temperature stability. Frank Austin is shown holding an example.

PERFORMANCE OF SYNTHETIC GREASES

E. R. Booser, A. E. Baker and E. G. Jackson • General Electric Company, West Lynn, Massachusetts

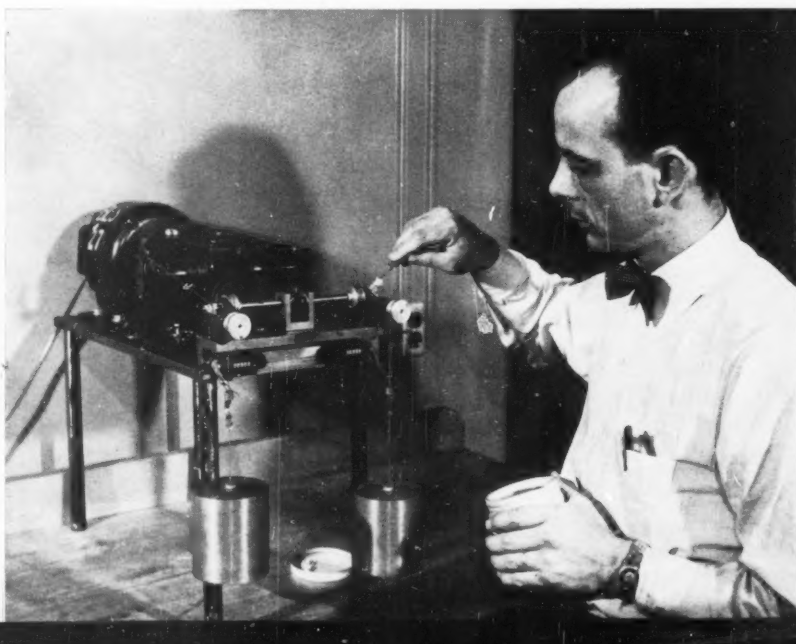
ABSTRACT

As airplanes fly higher and faster, and military vehicles of all types are expected to operate equally well in the frigid Antarctic or scorching desert sands, the versatility of synthetic lubricants is being demonstrated.

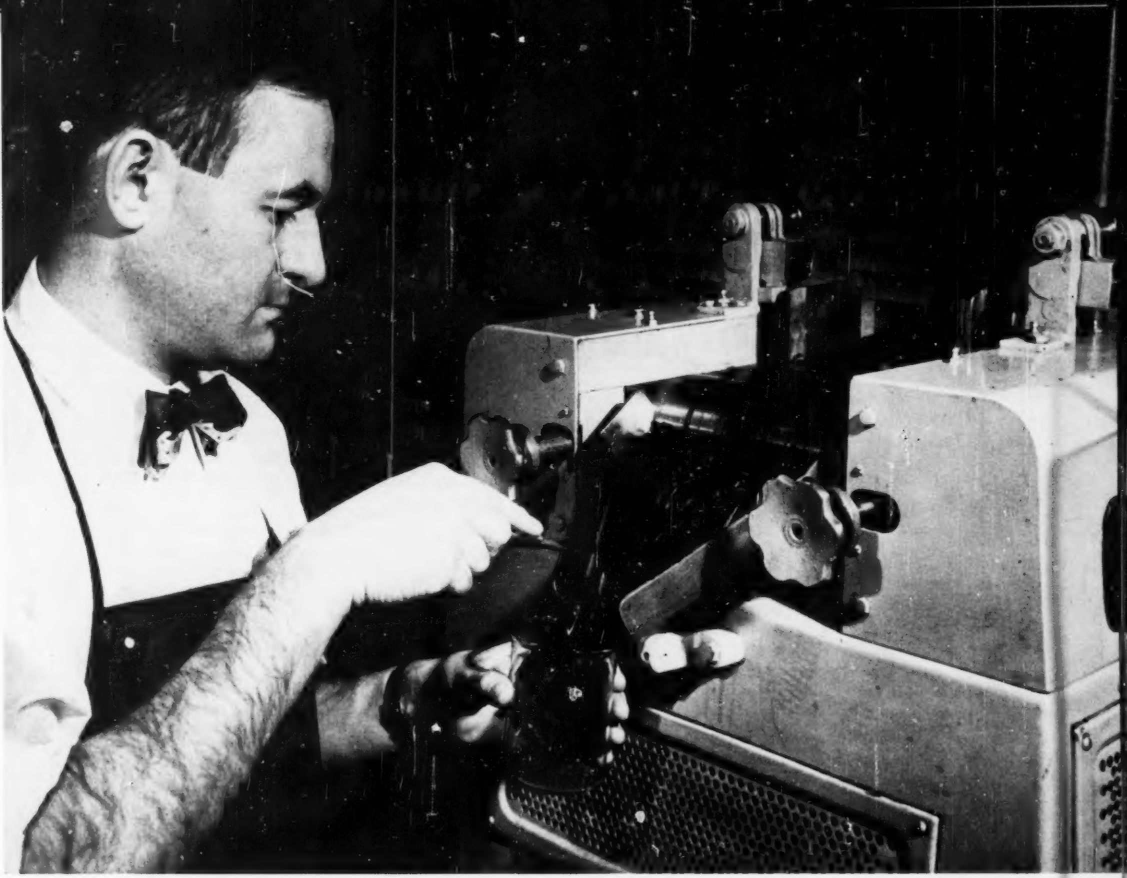
The magic silicones are used in greases for extremely low temperatures. At high temperatures the silicones also excel especially in ball bearings, although they leave something to be desired in the lubrication of gear teeth or sliding parts.

The much lower cost of petroleum lubricants dictates their continued use for the majority of applications, but for the hard to solve problems encountered at extremely high or extremely low temperatures, the more costly synthetics will find increasing application.

SYNTHETIC greases have been developed in recent years to provide lubrication under conditions which cause petroleum lubricants to deteriorate rapidly or to fail immediately. Difficult operations include high speed-low torque antenna drive motors which must respond instantly at very low temperatures, drive motor and instrument bearings operating near jet engines where ambient or soak-back temperatures may run to 250° C. and beyond, and other aircraft power units which have been made so compact that limited heat radiation results in high temperatures, excessive for petroleum greases. Particularly difficult are those cases in which the greases must have low torque characteristics at temperatures of the order of —50° C. and yet be sufficiently viscous as well as oxidation-resistant at higher than 125° C. While the impetus for development of extreme condition greases has been provided largely by the military, industry in general is finding many applications for these special products.



THE NAVY GEAR WEAR TESTER is used by Robert Webber for determining grease lubricity under severe sliding conditions.



SYNTHETIC GREASE is being prepared by Earl Jackson on a three-roll mill.

To meet these conditions, three principal types of fluids and a number of thickening agents have been developed. The most widely publicized and most versatile are the silicones. These fluids have exceptional volatility-pour point relationships and the viscosity vs. temperature curves are the flattest known. Furthermore, they generally do not cause rubber swelling or deterioration. They can be thickened with a number of materials including various soaps, silica gel, carbon black, bentonite and phthalocyanines. The best performances now are obtained with lithium soaps, but copper phthalocyanine shows promise as a high temperature thickener because of its stability toward oxidation and its good consistency characteristics (5). It does not, however, provide the additional lubricity that soap does.

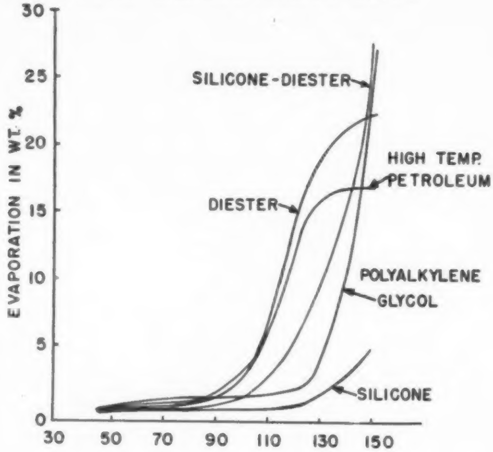
The silicones consist of silicon-oxygen chains of various lengths with various organic groups attached. The viscosity and volatility of the fluid are determined principally by the range of chain lengths. Oxidation stability and lubricity vary with the identity of the attached groups. Since silicones are often poor lubricating agents, additives or other fluids such as diesters are sometimes mixed with them in greases to improve this quality.

The diesters are another important class of synthetic fluids used in preparing greases. They are particularly useful in low temperature greases (to about —60° C.) where their better lubricity makes them superior to straight silicones. While their lower volatility makes them better than low viscosity petroleum fluids at high temperature, they are less resistant to oxidation than silicones. Mixtures of silicone and diester often combine good features of both, particularly for wide temperature ranges (—80° to +150° C.) The mixtures are also useful because the diester or some other mutual solvent is helpful in making a silicone-soap grease (11). The usual anti-oxidants are effective in both silicone and diester greases as well as in mixtures.

The diesters vary even more widely than silicones in molecular configuration, but for any given diester a more homogeneous fluid is obtainable because it is a high molecular weight monomer, not a polymer. Both the acid and the alcohol which form the diester may be varied so that any or all of the properties of the fluids may be changed. In general, high molecular weight and considerable branching of the carbon chain are desired in order to get low volatility and low pour point. Most diester greases use soap thickeners,

FIGURE 1

EVAPORATION VS TEMPERATURE OF TYPICAL SYNTHETIC GREASES AT 1000 HOURS



as low temperature applications are the more important and these present no oxidation problem.

The third type of fluid has unique properties which make it valuable for certain applications as an oil but less so in a grease. The polyethylene glycols on oxidation decompose into volatile products that, with sufficient ventilation, are removed completely from a bearing. This elimination of sludge formation in high temperature operation is a valuable asset for an oil, but a grease must contain a non-volatile thickener which eliminates this advantage. These polymeric ethers reportedly exhibit wide temperature range operation (—70° to 120° C.), low rubber swell, and with a silica thickener, they tend to stick to hot surfaces (12).

All greases made from the synthetic fluids have advantages over petroleum products in one or more applications, but they all have weak points, too. So, testing is a continuing program of trying new variations and combinations and always being alert for an entirely new product. Descriptions of some tests and the results obtained with synthetic greases are presented in the following sections.

Performance Tests

Bleeding and Evaporation

Since grease usually serves as an oil storehouse for bearings, bleeding and evaporation information is important in predicting grease performance. A good grease bleeds sufficient oil at a controlled rate to lubricate satisfactorily under the operating conditions. Thus, the objective use of bleeding and evaporation data obtained for extended periods of time and at various temperatures can be extremely useful.

Because synthetic greases are nearly synonymous with extreme temperature lubrication, bleeding and evaporation data obtained at high temperatures offer good criteria for preliminary selection for high temperature use. Such data may be used either separately for screening purposes or in conjunction with ball bearing grease tests and other functional evaluations. The data presented have been obtained by using a method similar to that outlined in the AN-G-3 specification. This consists essentially of weighing periodically a sample of grease in a metal cone, as it is allowed to bleed oil into two alternated beakers which are also weighed periodically. This system permits both evaporation and bleeding to be measured in one series of weighings.

Figure 1 presents evaporation after 1000 hours versus temperature for typical synthetic greases. The evaporation for all except the silicones sharply increase at temperatures between 100-125° C. The low loss with the silicone grease indicates its superiority for high temperature work. The abnormally high evaporation of the silicone-diester grease at 150° C. is interesting. This evaporation apparently results from the volatility of the diester component, and thus the suitability of the silicone-diester grease, for high temperature lubrication is largely dependent upon the physical properties of the diester.

The polyalkylene glycol grease also has high evaporation values at 150° C., increasing abruptly about 125° C. This occurs even when a high viscosity fluid is used in the grease composition because it represents decomposition of the fluid into volatile products during its rapid oxidation.

For comparison, a good high temperature petroleum grease is included. Its evaporation value at 150° C. is approximately midway between the silicone and the other three synthetic greases. It is of interest that the mean life of this grease in No. 306 bearings running at 3600 RPM and 150° C. was approximately 40% greater than the best of the other synthetic greases except for the straight silicone. Greases compounded from high viscosity, low volatility polyesters, however, will exceed the life of the petroleum grease.

FIGURE 2

BLEEDING VS TEMPERATURE OF TYPICAL SYNTHETIC GREASES AT 1000 HOURS

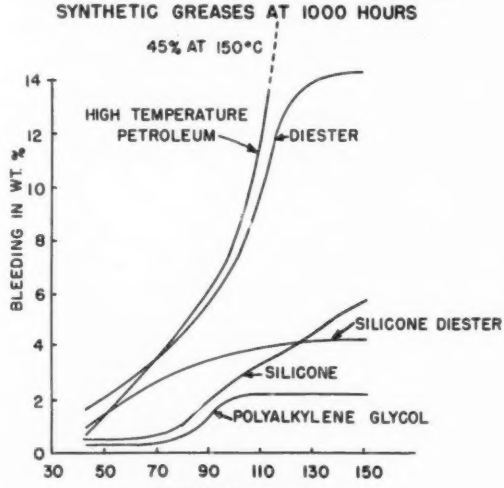
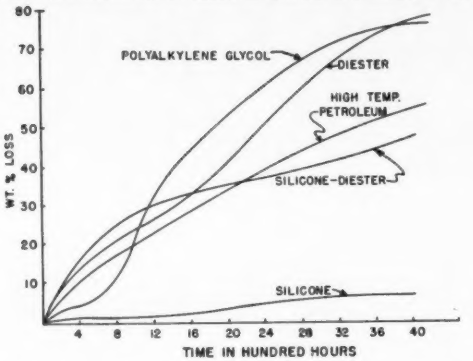


FIGURE 3

LONG TIME EVAPORATION OF SELECTED SYNTHETIC GREASES AT 150°



Thus, evaporation plays a critical role in establishing the life of a high temperature grease.

Figure 2 is a similar comparison of bleeding versus temperature on the same five greases. In this case, the silicone lubricants and the polyalkylene glycol grease have relatively low values, the diester somewhat higher and the petroleum base grease exceptionally high. Practically all synthetic greases exhibit low bleeding values. Bleeding, while an important criterion, is not as critical as evaporation.

In Figure 3, the evaporation values at 150° C. of the greases are shown up to 4000 hours. The most striking observation to be made from the curves is of the relatively low values obtained on the straight silicone grease. Although the evaporation rates at 150° C. of the diester grease and of the polyalkylene glycol grease are similar, the mechanisms are different. Loss in the polyalkylene glycol lubricant is due to evaporation of volatile decomposition products, while simple evaporation of the diester fluid occurs with the diester grease.

From an analysis of the data on bleeding and evaporation, the very interesting empirical relationship shown in Table I becomes evident. An initial assumption is made that a total loss of 15% by weight of a grease is a critical value for determining grease life.

Additional work is being done to try to develop an explanation for such a relation from the minimum oil requirements for ball bearing operation (12).

From an overall view of bleeding and evaporation data on greases, it can be stated generally that to obtain reasonably good bearing life, petroleum greases are suitable for use up to 100° C., diester, polyalkylene glycol and silicone-diester greases to 125° C. and the straight silicones to 150° C. or 200° C.

High Temperature Ball Bearing Operation

The life possible in No. 306 size ABEC-1 open ball bearings running at 150° C. with various types of greases is indicated in Table II. The results given are the geometric mean of five tests completed in a four-bearing test unit contained in a thermostated oven with the ambient temperature controlled to ±2° C. (13). This geometric mean approximates the median value obtained in these tests where logarithmic life values give a normal frequency distribution. A more detailed review of these results is planned in future reports.

The silicones generally give the longest life in these tests at 150° C., although some provide shorter operation than the better petroleum greases. The silicones would be expected to be particularly useful in bearings which are continuously very hot but in which operation is at low loads, low speeds, or only intermittent in nature. In the absence of severe steel-on-steel sliding in ball bearings which taxes the poor lubricity of the silicones, their good oxidation and thermal stability would offer maximum benefits. The superiority of silicone greases in a recent cooperative high temperature ball bearing grease testing program was reported by Javitz (4).

Very good results were also obtained with some polyester greases and with a few high temperature petroleum greases. Diester, silicone-diester, and polyalkylene glycol products were similar to many petroleum greases in their performance. Evaporation of the diester fluids and oxidation of the polyglycols were probably the life determining factors in greases made with such oils.

The principal requirement for good high temperature operation with any grease is stability. This includes oxidation stability and low volatility of the oil, oxidation stability of the soap and structural stability of the grease to give a slow, steady rate of oil bleeding into the bearing. The oxidation instability of polyglycol, petroleum, and ester fluids will probably continue to dictate the general use of silicones as replacements for petroleum greases for long-time operation in the temperature region above about 100° C. Some polyester greases might also prove useful in the range of 100 to 150° C. The upper limit possible with silicones will be better established by performance tests in bearings fabricated from high temperature steels. Preliminary indications are that short-time operation may be possible up to about 225° C. with special thickeners such as that in the copper phthalocyanine-silicone grease developed by Fitzsimmons (5, 6).

Low Temperature Torque

The low temperature torque characteristics of synthetic greases are compared with two petroleum greases in Table

Table I

COMPARISON OF BALL BEARING GREASE LIFE WITH BLEEDING AND EVAPORATION RESULTS

Grease	Hours Geometric Mean Life in No. 306 Open Bearings 150° C. 3600 RPM	Hours for 15% Bleeding and Evaporation Loss at 150° C.
Silicone	1700	1500
High Temperature Petroleum	700	200
Diester	510	400
Diester	290	200
Polyalkylene Glycol	200	700

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Table II

HIGH TEMPERATURE GREASE LIFE IN BALL BEARINGS

Open No. 306 ABEC-1 Bearings; Grease-Packed Caps; 3600 RPM; 160 Pounds Radial Load; 150° C.

Grease	Geometric Mean Life, Hours
Petroleum	
Best of 22	850
Worst	100
Silicone	
Lithium Soap—Low Phenyl Silicone Oil	3800
Lithium Soap—Medium Phenyl Silicone Oil	1900
Lithium Soap— " " " "	1700
Lithium Soap— " " " "	580
Ester	
Lithium Soap—Diester	510
Lithium Soap—Polyester	1000
Silicone—Diester	
Lithium Soap	680
Polyglycol	
Lithium Soap	180

Table III

LOW TEMPERATURE TORQUE

Fully packed No. 204 open ball bearing rotated 1 RPM

	Torque, Gm - Cm			
	—55° C.		—73° C.	
Grease	Start	Run	Start	Run
Petroleum				
Conventional	42,000	18,000	....	....
Low Temperature	660	320	....	....
Diester				
MIL-G-3278 Lowest	670	230	2000	2000
Highest	1460	330	....	....
Copper Phthalocyanine	720	120	....	....
MIL-L-7421	600	150	1650	510
G. E. Experimental	290	120	700	310
Silicone				
Medium Phenyl	21,500	20,900	....	....
Low Phenyl	630	150	....	....
Methyl	110	75	....	....
Methyl	....	....	75	65
Silicone-Diester	150	105	290	140
Glycol-diester	560	270	....	....
Alkyl Silicate	....	....	470	270

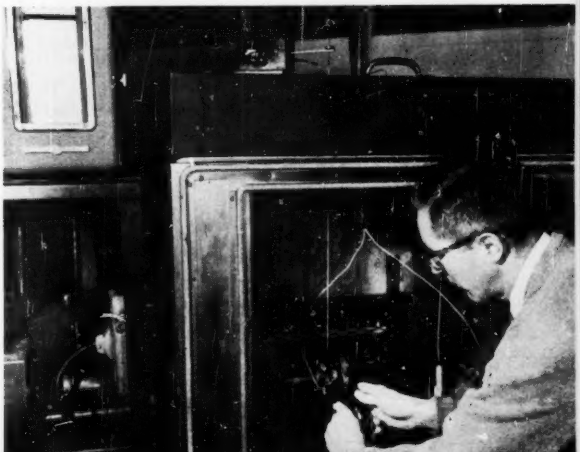
III and a general comparison is indicated in Figure 4. The torque values were obtained in a conventional ABEC-1 No. 204 ball bearing turning at 1 rpm after a two-hour soaking period at the test temperature. A starting torque of approximately 1000 gram centimeters is reached in this test at the lowest temperature at which a grease will permit operation of many electric motors and other devices where moderate torque is available.

The best low temperature characteristics were obtained with greases containing a large proportion of methyl silicone fluids. These methyl silicones have excellent viscosity-temperature characteristics, and their low viscosity at low temperatures makes possible the formulation of greases with outstanding torque characteristics at a temperature of —75° C. Silicone-diester greases, in which a diester oil is incorporated with the silicone oil to provide a better grease structure, also display excellent low temperature properties (11). The selective lubricity properties of such formulations are reviewed in the next section.

Increasing the phenyl content of a silicone oil decreases the good low temperature properties. Some greases formulated with low phenyl content oils, however, appear outstanding in providing satisfactory operation at temperatures as low as —55° C. while giving excellent life at temperatures up to 150° C. or higher. Medium to high phenyl content in silicone fluids for greases allows operation only down to about —35° C. and provides shorter life at high temperature in conventional ball bearings.

Diester greases, which are the most commonly employed commercial type for use at temperatures in the region of —55° C. vary greatly in properties. The poorer greases covered by the MIL-G-3278 specification require a considerable break away torque at —55° C. Even the best of this type must be applied sparingly to permit operation of small motors and instruments used in aircraft. Trouble with low temperature performance of these diester greases has led to a study of various formulations and the establishment of a new MIL-L-7421 military specification for a diester grease for use down to —73° C. An indication of the possibilities for improvement of the diester type grease is indicated in the good characteristics of the experimental diester grease of Table III. This was also satisfactory in ball bearing life tests at 150° C. and in the Navy Gear Wear Test.

MEASUREMENT is made by Ernest Scott of a low temperature ball bearing torque in a cold box.



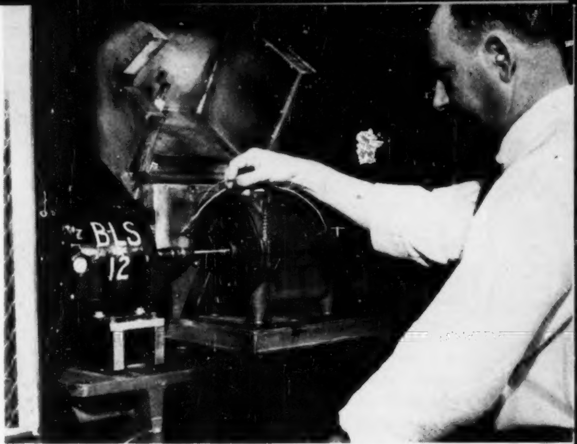
Glycol-diester type oils have been used with some success in low temperature greases. Silicate fluids, although they have not been established as having satisfactory hydrolysis and other performance properties, give good low temperature torque. Polyester oils produce greases with low temperature properties intermediate between those obtainable with diesters and conventional petroleum oils.

Lithium soaps have been used almost exclusively as the thickening agents in low temperature greases. A change from lithium soap to copper phthalocyanine gave no appreciable change in break-away torque for a diester grease.

Lubricity

The relative effectiveness of greases for reducing the wear and surface damage which might be expected on the sliding surfaces of cams, screws, guides, pivots and bearings can be determined by the Navy Gear Wear Test. The results with several variations of aircraft greases have recently been presented in the literature (8); and a good correlation was indicated with grease performance in aircraft instruments and control devices. Essentially, this test uses a pair of spiral instrument gears oscillating back and forth through 360 degrees under undirectional torque load after being coated with a test grease. Although the MIL-G-3278 specification test requires a brass gear in combination with one of 18-8 stainless, various gear materials can be used advantageously to determine other suitable grease-material combinations. In general, gear wear of less than 2.5 mg. per 1000 cycles with a 5 lb. load and less than 3.5 mg. per 1000 cycles with a 10 lb. load has been found indicative of satisfactory lubricity for aircraft applications.

The Gear Wear results with various synthetic greases are compared in Table IV with the characteristics of petroleum greases. A great range was encountered with the petroleum products; soft, high-bleeding greases gave low wear while



A BALL BEARING GREASE LIFE TESTER is shown with Thomas Cooke. Such a tester holds four bearings maintained at constant load and temperature until failure of one of the bearings occurs.

FIGURE 4

LOW TEMPERATURE TORQUE GROUPING OF GREASES

No. 204 Fully Packed Open Ball Bearing

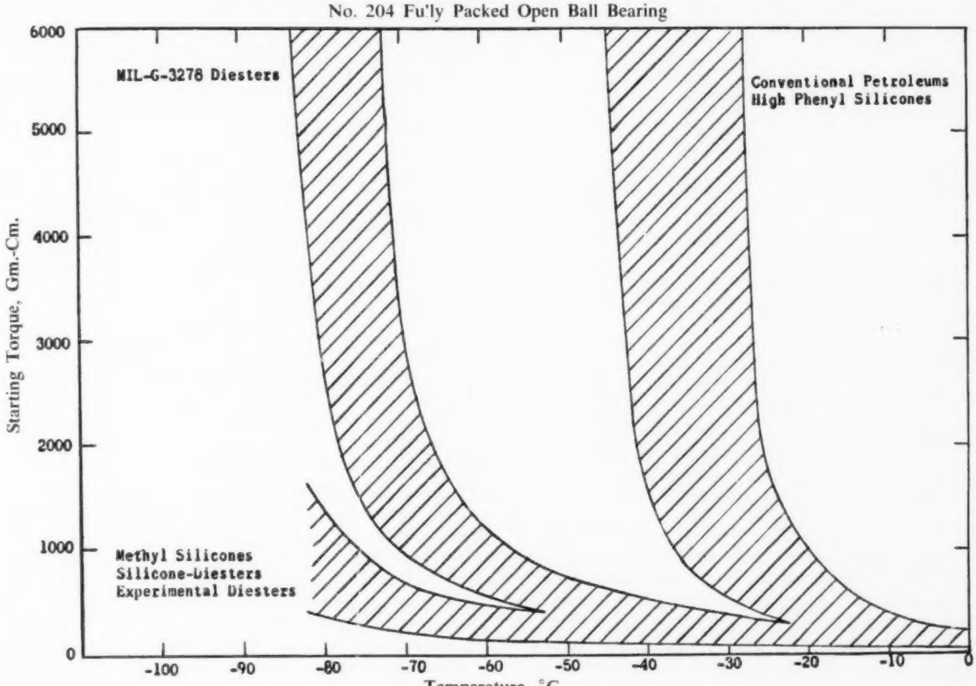


Table IV

GEAR WEAR TESTS

Brass-stainless steel gear combinations as in MIL-G-3278 specification.

Grease	Mg Wear/1000 Cycles 5 Lb. Load	Mg Wear/1000 Cycles 10 Lb. Load
Petroleum		
Best of 11	1.0	0.7
Worst	Fail at 403 Cycles	
Diesters		
Best of 7	0.3	0.6
Worst	1.4	1.1
Extreme Pressure Diesters		
AN-G-10	1.5	6.6
MIL-G-7118	1.6	4.0
Polyester		
Lithium Soap	1.3	1.8
Polyalkylene Glycol		
Lithium Soap	3.9	8.2
Alkyl Silicate		
Lithium Soap	1.4	Fail at 1672 Cycles
Silicones		
Lithium Soap—Medium Phenyl Silicone Oil	Fail at 323 Cycles	
Lithium Soap—Medium Phenyl Silicone Oil	Fail at 592 Cycles	
Silicone-Diester		
Lithium Soap	2.0	Fail at 243 Cycles

early failure was encountered with stiff, dry materials. Few general differences were noted, however, with various soap types in the petroleum greases.

Diester type greases gave the best results in these tests, and none gave more than very slight wear. The silicones were all very poor with the brass-stainless steel combination, as were greases containing silicone-diester mixtures or silicate fluids. Relatively poor results with extreme pressure agents in diester greases probably result from corrosion of the brass gear by the chemically active additives.

Poor results in one particular material combination do not indicate that other desirable characteristics of a grease cannot be utilized. The extremely good low temperature characteristics of silicone-diester greases make them appear useful at temperatures below —75° C. By proper selection of sliding materials, they can be used in various other mechanical components as well as in ball bearings with their relatively mild lubrication requirements. Table V indicates, for example, that bronze can be used successfully when rubbing against various steels with a silicone-diester grease as a lubricant. Selection of material combinations for high temperature silicone lubricants can similarly be made from literature reports (4, 7).

Field Utility

The usefulness of synthetic greases, in general, shows up in longer life at high temperatures and in easier operation at very low temperatures. In obtaining such extreme temperature characteristics, caution must be observed that the synthetic grease will provide satisfactory lubricity. Wear with some metal combinations, such as steel against steel, is very troublesome with silicone lubricants which are otherwise ideal for operation over extreme temperature ranges. The preceding laboratory evaluations help give some indication of the potentialities and limitations involved for the various types of synthetic greases. A generalized discussion follows comparing these laboratory test results with performance in typical field applications.

For relating test results to field applications, Table VI summarizes some performance characteristics of a typical grease of each type which either is or was at one time in commercial or semi-commercial production. A soda base petroleum grease is included for comparison. It had a worked penetration of 285 and contained an oil of 300 Saybolt second viscosity at 100° F.

Some idea of the upper practical operating temperature with each type is given by the top temperature at which a median life of 1000 hours might be expected in a heat stabilized ABEC-1 ball bearing running under moderate load. These values represent extrapolations and interpolations of tests run at 100° C., 125° C. and 150° C. Although considerable variation is encountered from grease to grease within one given type, silicones head the list for high temperature performance.

As a consequence of their good high temperature stability, the silicone greases, generally prepared from methyl phenyl silicone oils and lithium soaps, are finding considerable industrial application (3). They are used in both sealed and open ball bearings in motors and generators at temperatures above 100° C. They have greatly relieved maintenance problems with bearings used in high temperature conveyors. Controls, instruments and other equipment associated with kilns, furnaces, and various heat treating and chemical processes have been provided with considerably improved life. The poor lubricity characteristics of the silicone greases are generally not troublesome in ball bearings when adequate bearing radial play is used (9). Wear in sliding mechanical parts is frequently very bad, but can be relieved in some cases by proper material selections (4, 7).

The silicone-diesters are by far the most outstanding of the grease types in Table VI for satisfactory low temperature torque. Of limited commercial availability, they have been finding application as lubricants for rubber seals in aircraft pneumatic systems. They have also been finding some use as extreme low temperature ball bearing lubricants where only very low torque is available. Lubricity and wear problems with this type of grease are nearly as severe as with high temperature silicone greases.

The lithium soap-diester greases are useful in most applications from about —60 to +130° C. This broad operating temperature range, together with outstanding lubricity properties which minimize wear in many material combinations and with good rust preventive properties, has resulted in almost exclusive use of this type in aircraft applications (2, 8). Some use is also found in refrigeration equipment and in various outdoor applications in Arctic climates. Occasional use is made of these greases at normal temperatures because of their good lubricity in sleeve bearings, pivots, gears and instruments operating under severe rubbing conditions. Much broader general purpose use would probably be made of the diester greases if their price were competitive with petroleum products.

Some limited evaluations of greases prepared from polyester oils indicate they are excellent products offering both better high temperature and low temperature performance than petroleum greases. Too high torque at low temperature for military use and lack of commercial availability have restricted field applications.

Polyalkylene glycol greases may find some use because of the special characteristics of the fluids used. In general, however, their low temperature properties and high temperature stability compare unfavorably with diester-type greases.

Future Trends

In the industrial field petroleum greases will continue to be used preponderantly for many years to come. The performance characteristics of high quality petroleum greases under conditions normally encountered in machinery are generally better than those of any synthetics, and the cost factor heavily favors the petroleum products.

Industrial use of synthetic greases on a somewhat broader scale will come, however, with better knowledge of their special performance properties and with changes in industrial equipment. Development of high temperature motors and generators, for instance, could introduce a broad new field of use for the high temperature silicone greases.

In expensive electronic computers and controls where the grease cost is negligible, diester greases will probably be brought into play to a wider extent because of their special lubricity properties.

Table V

GEAR WEAR TEST RESULTS
WITH SILICONE DIESTER GREASE

Left Hand Gear	Right Hand Gear	Mg. Wear/1000 Cycles 10 Lb. Load	
		Left	Right
AISI 4142 Soft Steel (R_C 28)*	Tin Bronze (R_B 40)	0.0	0.7
	Aluminum Bronze (R_B 89)	—	1.1
	AISI 4142 Soft Steel (R_C 25)	Fail at 82 Cycles	
	AISI 4142 Hard Steel (R_C 45)	Fail at 298 Cycles	
	AISI 440C Stainless (R_C 55)	Fail at 1258 Cycles	
	AISI 416 Stainless (R_C 25)	Fail at 26 Cycles	
AISI 4142 Hard Steel (R_C 47)	Tin Bronze	0.8	0.3
	Aluminum Bronze	—	0.7
	AISI 4142 Soft Steel	0.2	24.6
	AISI 4142 Hard Steel	Fail at 1464 Cycles	
	AISI 440C Stainless	Fail at 2135 Cycles	
	AISI 416 Stainless	Fail at 138 Cycles	
AISI 440C Stainless (R_C 56)	Tin Bronze	0.0	0.7
	Aluminum Bronze	0.2	2.8
	AISI 4142 Soft Steel	Fail at 836 Cycles	
	AISI 4142 Hard Steel	Fail at 2922 Cycles	
	AISI 440C Stainless	0.0	0.1
	AISI 416 Stainless	Fail at 144 Cycles	
AISI 416 Stainless (R_C 25)	Tin Bronze	0.0	0.9
	Aluminum Bronze	2.2	0.7
	AISI 4142 Soft Steel	Fail at 130 Cycles	
	AISI 4142 Hard Steel	Fail at 62 Cycles	
	AISI 440C Stainless	Fail at 153 Cycles	
	AISI 416 Stainless	Fail at 149 Cycles	

*Rockwell hardness in parentheses.

Table VI

SUMMARY OF CHARACTERISTICS OF SYNTHETIC GREASES

	Max. Temp. for 1000 Hrs. No. 306 Ball Brg. Life, ° C.	Lowest Temp. for 1000 Gm-CM Torque in No. 204 Ball Brg., ° C.	Navy Gear Wear Mg/1000 Cycles at 10 lb. Load	Approx. Cost $/lb.
High Temperature				
Silicone	170	—35	Fail	$6.50
Polyester	150	—50	1.8	2.00
Silicone-Diester	140	<—80	Fail	6.50
Diester	130	—60	0.8	2.00
Polyglycol	115	—35	8.2	1.75
Petroleum	115	—30	2.8	0.20

For aircraft and military equipment, the diester greases will continue to find much use because of their wide temperature range; and in special applications the high temperature silicone and low temperature silicone-diester greases should find increasing use.

Lubricants for use in the range of 200 to 400° C. and higher should continue to be a goal. With them, many of the present design problems in cooling and lubricating bearings in gas turbines, aircraft equipment and various industrial devices would disappear.

Acknowledgments

Appreciation is expressed to the Naval Research Laboratory and to R. B. McBride, H. F. Lamoreaux, M. C. Agens, and N. G. Holdstock of the General Electric Company for supplying a number of experimental greases for which data are given in this report.

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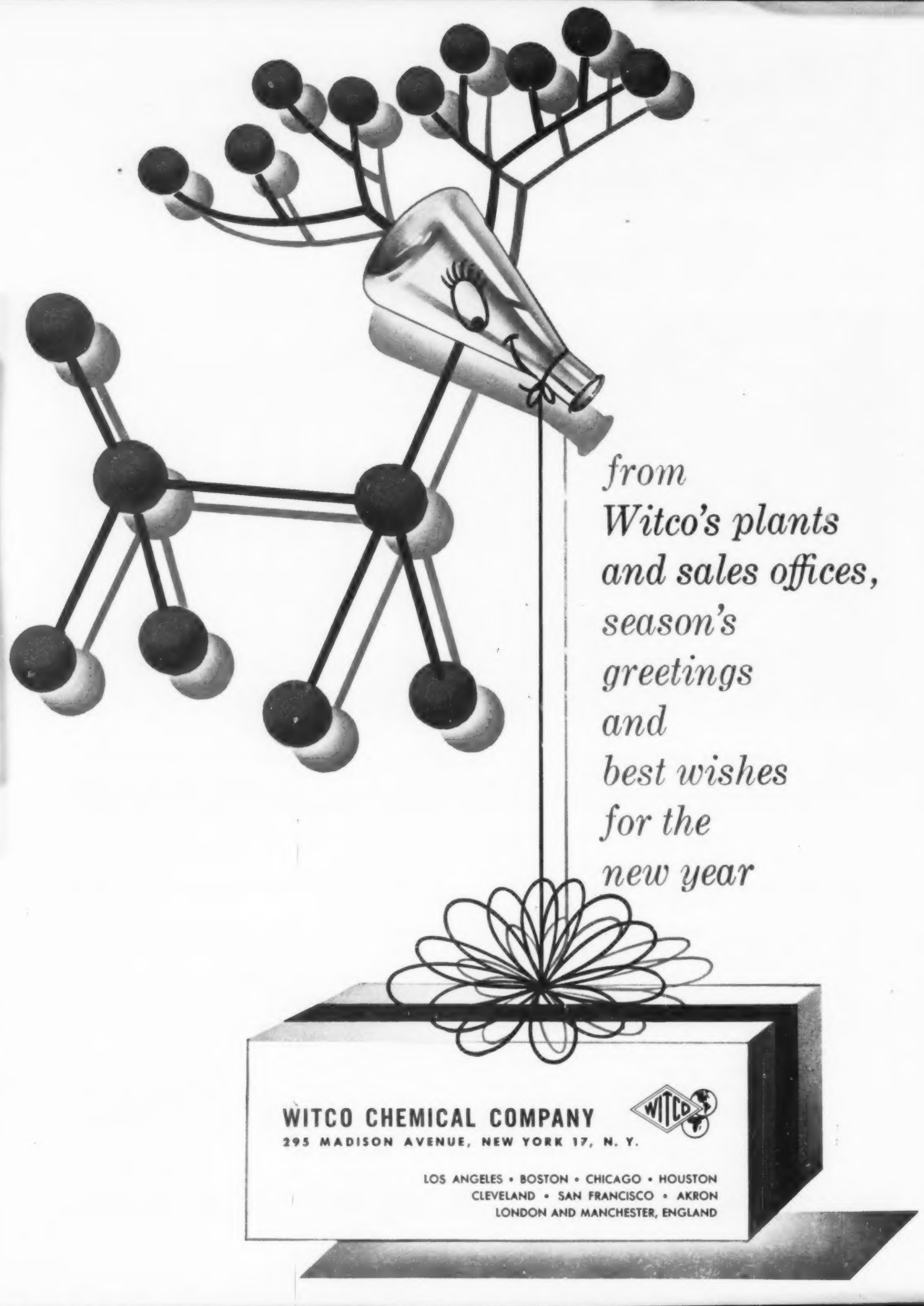
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20th Annual Meeting

Draws Record Attendance

RIGHT, TAKING A LOOK at the Spokesman are (left to right): G. M. Rhode, D-A Lubricant Company, Inc.; F. H. Ott, Union Oil of California; H. A. Mayor, Jr., and Robert L. Jolley, Southwest Grease & Oil Co., Inc., and P. J. Baker, The Girdler Corporation.

LEFT, DURING REGISTRATION was a good time to get together for (left to right): J. G. Swift, McColl Frontenac Oil Company, Ltd.; C. E. Cosby, Mallinckrodt Chemical Works; Aubrey D. Morgan and Carl Shanks, Panther Oil & Grease Manufacturing Co.

N L G I's Twentieth Annual Meeting drew the largest attendance in the organization's history. During the three-day session from October 27th to 29th, members and guests heard a broad review of current lubricating grease progress.

Application to railway journal bearings to whether lithium will remain in short supply and on to a continuous method of manufacturing this type of lubricant occupied the time of a full meeting room the first day.

The second day opened again to a filled room that listened attentively to a highly technical paper explaining the flow of lubricating grease between parallel planes. After that came papers on additives followed by another on that relative newcomer to the field—synthetic greases.

The afternoon of the second day saw an increased crowd listening to papers on silica aerogel-thickened greases. Then came two others which described grease development and problems encountered by th USAF. The final paper covered progress made by the NLGI Fellowship at the University of Southern California.

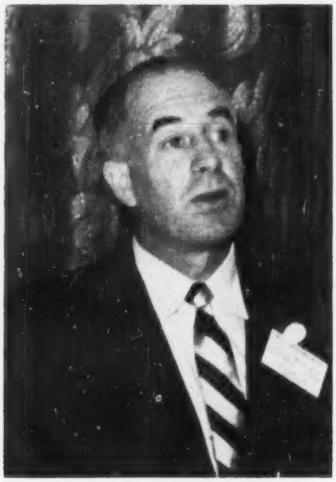
Pictured on this page are a few of 496 delegates as they gathered in the Edgewater's Passagio, just before and after registering prior to the opening session on Monday. Following pages give you glimpses of the Board of Directors and Officers serving N L G I during the coming year, the three awards presented during the annual banquet, and a new feature in the form of a symposium during the Technical Committee Session on Wednesday.

W. W. HARRIS (left) and W. J. STRAKA, Harshaw Chemical Company, commented on the early arrival of a good crowd, which leads to a very successful meeting.

BUSINESS IS FORGOTTEN in this conversation among E. W. Nelson (left), Continental Oil Company; R. F. Nelson and F. T. Crookshank, The Texas Company.

Speakers . . . .

Pictured here are four of the ten speakers who addressed the General Sessions.



R. T. MACDONALD

NEAL BOWMAN

E. R. BOOSER

PETER J. BAKER

For the first time a general interest speaker was heard at the general sessions with Dr. Neal Bowman from the National Association of Manufacturers. First speaker on the program, he added sparkle and thought to current social problems facing everyone. Nine technical papers followed that afternoon and the following day. Subjects ranged from application to manufacture. Here you will get an idea of a few speakers at the generall sessions. Their complete addresses will appear in later issues.

Board

AT A BOARD OF DIRECTORS LUNCHEON are (left to right): W. W. Albright, W. M. Murray, M. R. Bower, A. J. Daniel, H. P. Hobart, B. G. Symon, G. A. Olsen, L. W. McLennan, H. L. Hemmingway, H. A. Mayor, R. Cubicciotti, J. W. Lane, J. R. Corbett, F. E. Rosenstiehl, W. H. Saunders, Jr., and C. B. Karns. Not pictured are H. B. Stone and G. E. Merkle.

Officers

NEW OFFICERS discuss a business matter. They are G. A. Olsen (left), W. W. Albright and A. J. Daniel.

Pictured above is the twenty-first Board of Directors to serve the lubricating grease industry through N L G I. Absent is newly elected Director, H. B. Stone and retiring President G. E. Merkle, who was presiding at the afternoon general session when the picture was taken.

At the left is Sunland's President who has just become N L G I's 19th Vice President. Standard's (Indiana) W. W. Albright, newly elected President and the 20th to head the organization. Sixth Treasurer to hold N L G I's purse strings is Battenfeld's A. J. Daniel.

Awards

LEFT . . . . John J. Reinecke, President of American Trade Association Executives, hands that organizations Grand Award for Distinguished Service to NLGI's President G. E. Merkle. Award is presented each year to the trade association judged to have rendered the greatest service to its members and public.

For the first time NLGI presented its own awards to outstanding individuals selected for service to the Institute and industry.

LEFT ABOVE . . . . is Battenfeld's George W. Miller receiving his award from President G. E. Merkle in recognition for past service to the Institute as Secretary over a number of years.

RIGHT ABOVE . . . . T. G. Roehner (Socony-Vacuum) receiving a similar award for present service to NLGI as Chairman of the Technical Committee. Both awards were clocks complete with thermometer and barometer.

LEFT . . . . retiring President (1952) G. E. Merkle receives the gold key from A. J. Daniel.

PRESENTATION OF GRAND AWARD FOR DISTINGUISHED SERVICE

presentation address
by
John J. Reinecke, President
American Trade Association Executives

Perhaps not all of you know just what the American Trade Association Executives, or ATAE, is, so some explanation may be in order. The Department of Commerce lists 15,000 Trade Associations in its directories, but, of course, not all of them represent industries as large as this one or my own.

Foreigners are amazed and accuse Americans of being a nation of joiners. Like the fleas having the littler fleas on them, and on down the line, we Trade Association Executive are not unique. We, too, have our own Association which is ATAE. It might be described as the professional society or the "Bar Association" in this field. We have more than 1300 members representing 1000 industries or businesses. The associations represented in ATAE are made up of members ranging in number from three to more than 100,000. The ATAE directory reads like a "Who's Who" of business and in it is represented almost the entire economy of our country.

To stimulate effort on the part of industry and associations, ATAE each year invites its member associations to compete for awards for distinguished service. The competition is always very keen, and it is considered the highest of honors for an association to receive any one of these awards. As its name implies, the Grand Award, of course, tops them all. There is a distinguished Jury of Awards which judges the many entries. The Jury is under the chairmanship of the Hon. Charles Sawyer, Secretary of Commerce; Wm. J. Greede, president of NAM; Dechard Hulcy, president of the U. S. Chamber of Commerce; Edward H. Stromberg, director publicity and publications, Northwestern University; Dr. Ray B. Westerfield, Professor of Economics, Yale University.

It is my pleasure this evening to present the Grand Award for 1952 to President Merkel who, I am sure, will be pleased to accept it in the name of the National Lubricating Grease Institute. The citation states "for its excellent service to its industry and the public, and especially for its leadership in Trade Association work during the past year."

Among your many and varied activities, the jury recognized and rated several of your activities outstanding. For example, your guidance and cooperation with the American Association of Railroads, the Anti-Friction Bearing Manufacturers, and others in promoting the use of roller bearings on freight cars was recognized as exceptional leadership and excelled that of other Associations in the entries submitted. The work of Chairmen Roehner and Cubicciotti and their committees was recognized as being an outstanding example of leadership and the Institute is indebted to these men for their contribution.

Likewise, your program of cooperation with the American Petroleum Institute, the Steel Package Institute, and the Dispensing Equipment Manufacturers, in developing the program of standardization of drums, dispensing equipment and other materials was considered as being an unusual service to business and the public.

In conclusion, I would like to thank and compliment your Board of Directors and you, the members of the Institute, for your unselfish contribution to Trade Association work in general by making your headquarters office and staff available for service to the trade association work in general. Over the past several years, your association has supplied ATAE with a member of several committees, a board member, and currently one of the vice-presidents. Speaking from my own personal experience, I know that your association has benefitted in proportion to this contribution.

Ladies and gentlemen, it is now my great pleasure to present the ATAE Grand Award to President Merkel, who will receive it in behalf of the National Lubricating Grease Institute.

T. E. DeVilliers, Chairman of the Committee that planned the symposium.

At the microphone is E. Scott Pattison addressing the session, while NLGI's Technical Committee Chairman, T. G. Roehner, listens attentively.

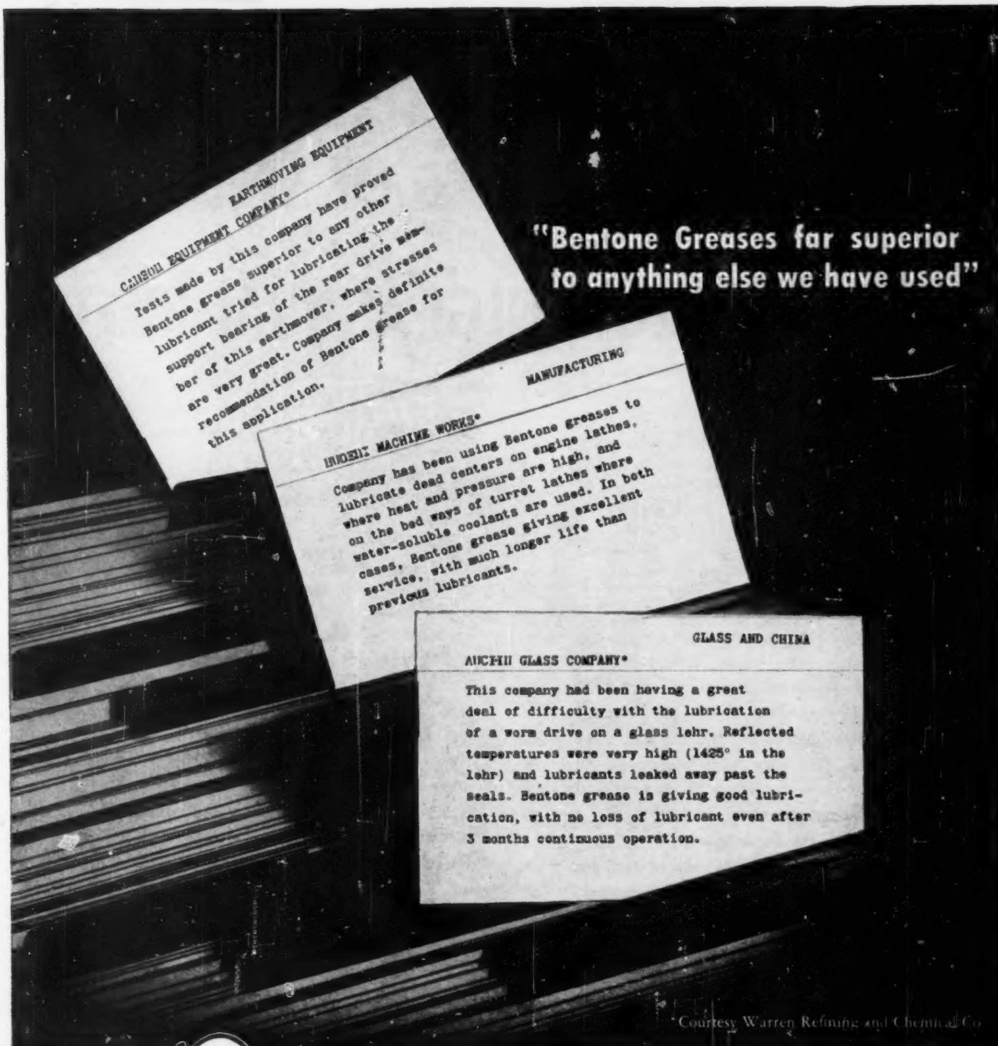
Technical Committee

Another first came at the Technical Committee Meeting with its symposium on utilization of fatty acids. Here are views of some of the speakers presenting prepared papers. At bottom of page is the panel discussing the subject. Upper left of the page is T. E. De Villiers, who headed the committee that planned the session. Reports indicate plans were well carried out and session a complete success.

L. C. Brunstrum illustrates a point from his prepared discussion.

H. C. Meyer, Jr., presents his prepared discussion.

LEFT TO RIGHT . . . . B. W. Schroeder (Archer-Daniels-Midland), E. H. Blumen (W. C. Hardesty), J. E. Farbak (Swift & Co.), James M. Kiefer (Armour Chemical Div.), R. D. Aylesworth (Emery Industries), H. A. Hamilton (General Mills), J. D. Hetchler (Archer-Daniels-Midland) and E. Scott Pattison (American Soap and Glycerine Producers, Inc.).



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ADDRESS OF WELCOME AT 20th NLGI ANNUAL MEETING

by
G. E. Merkle, President
National Lubricating
Grease Institute

Members of the National Lubricating Grease Institute, guests and gentlemen, I deem it a great honor and privilege to welcome you here today to our 20th Annual Convention. It is most gratifying to your Officers and Directors to see today the largest attendance in our history. In behalf of our Officers and Directors, I want to thank you for your interest in our meetings as evidenced by your ever increasing attendence. We know how busy many of you are and how many other meetings there are calling on your time. In spite of the exceptional competition we had last year, our attendance was the greatest to date and this year advance indications are that we will greatly exceed last year's attendance.

It has been the aim of your Directors and Program Committees each year to offer a well rounded program to satisfy the interests of our various classifications of members as well as good entertainment after our annual banquet. This year I know you will enjoy a very interesting and informative program. The subjects are timely and pertinent to our members' problems.

During our 20 years of existence, we have steadily grown from a small group back in 1933 to our present size, which includes most of the grease manufacturers in the U. S. and many Associate Members who comprise those supplying raw materials, containers, or equipment to Grease Manufacturers. We also now boast of members in six or more foreign countries.

One not knowing of the activities of our Institute might think that we are a non-technical group. Attendance at our meetings and reading the papers presented at our meetings will most certainly change such thinking. Many papers sound more like the product of research laboratories, than might be expected, and only prove that our industry has made great strides technically and scientifically.

The National Lubricating Grease Institute has done much to gain recognition for our industry. We publish a monthly magazine which contains many articles by members and others, a column of patent abstracts, and a technical column by the Chairman of the Technical Committee. In addition to our number of copies of the "Spokesman" to which members are entitled, we find that many are ordering many additional copies for distribution among their personnel. A large number of copies are sent to non-members and we are presently mailing them to no less than 18 countries outside of the United States. Such a demand for our publication indicates the recognition our Institute has received nationally and internationally.

This year on September 22 at a meeting in Toronto, Canada, we were presented with the "GRAND AWARD" for distinguished service. This award is presented each year to organizations like ours, which, in the judgment of a jury, have rendered the greatest service to the industry represented. The jury selected was composed of men of high positions like Secretary of Commerce, Charles Sawyer, the President of the National Manufacturers Association, Mr. Hulcy, President of the Chamber of Commerce, Mr. E. H. Stromberg of Northwestern University, and Dr. Ray B. Westerfield of Yale. This is an award we can feel justly proud to receive as there are thousands of such associations in competition.

For the past several years Mr. Ted Roehner has been Chairman of our Technical Committee. He has been ably assisted by Co-Chairmen Mr. William Oldacre and Mr.

Hugh Hemmingway. Under Mr. Roehner's leadership the Technical Committee has taken on many problems of prime importance to our industry and has made considerable progress on all of them. Here are some of the problems studied: (1) Pumpability of Grease which required considerable co-operative work between manufacturers of dispensing equipment and manufacturers of greases. From this work we expect profitable results. (2) Another problem being handled by our Technical Committee is the study of lubrication of Railway Anti-Friction Bearings as members of this committee are serving jointly with representatives of A. A. R. and representatives of the bearing manufacturers. Our contribution in this work has been considerable and valuable. (3) We have also served on a joint committee with the ball bearing manufacturers and real progress has been made by this committee.

Since 1950 we have cooperated on a Joint Committee with A. P. I. on container problems. First we were concerned with the availability of drums and cans for our industry and later studied the possible simplification of the many sizes and styles of containers. This is a very active Committee headed by Mr. Cubiccotti and has accomplished considerable to the benefit of our industry as well as to container and equipment manufacturers.

For the past two years we have sponsored a Fellowship at the University of Southern California. This Fellowship is under the direction of Dr. Vold and covers the electron microscopic studies of the soap structures of lubricating greases. We had a report on this work at our meetings last year and will again have a report at this meeting. We expect this work to contribute considerable to our knowledge of lubricants and lubrication.

The Directors of the Institute during this year have voted to recognize the N.L.G.I. member who has contributed most to the welfare of our organization. The contribution may be in the form of articles for the "Spokesman" or some outstanding service to the Institute. It is felt that the existence of such an inducement may stimulate contributions to our publication. The reward for such recognition is left to the discretion of a special committee appointed for this purpose. We hope this award and the honor that accompanies it will attract much of our latent talent.

We manufacturers of lubricants are so saturated with our problems that we are likely to overlook and underestimate our importance to industry and our way of life. When we think about it we are fully aware of the fact that without proper lubricants no machinery could operate. This would affect the production of food, clothing, building materials, our war effort which today is so highly mechanized. It is essential for air, rail, water, and motor travel. Wherever there is friction, lubrication is required.

Modern wars call for aviation and instrument lubricants to meet high and low temperatures far more severe than it was possible to meet only a few years ago.

Industry has imposed many new and severe requirements which until recently were unknown. We have been able to make products to meet these severe requirements only because of the time, effort and technical talent our industry has assigned to the task and at a considerable cost.

In recent years a multitude of new greases have been developed which differ considerably from the old conventional lubricants. They find application where extreme conditions prevail. The so-called conventional lubricants still play a large role and satisfy most of the requirements.

The use of additives for oxidation resistance, for prevention of corrosion, for increasing film strength have served useful purposes.

Various non-petroleum products are found useful in lubricants in which low volatility is required at high temperatures and when very low temperatures are encountered.

In recent years there has been a considerable increase in the production of Lithium Greases as multi-purpose greases because of their wide range of application and possible elimination of some dispensing equipment. Shortages of Lithium for our industry have curbed the development considerably but if and when the present "Police action" in Korea ceases, there will probably be a greatly stepped-up production of these greases.

Some progress has been made in the development of the Bentone type lubricants. These too meet the exceptional temperature conditions, especially the high temperatures.

There are numerous new and only partially developed greases to appear in the near future due to the tremendous amount of work being done to improve on one characteristic or another of existing lubricants. Many may serve for only limited uses due to cost or other limitations.

We cannot overestimate the value of our service to the world for without our products it would surely be a small world and none of us would attend this meeting today. We wouldn't walk that far.

As you all know, this is a very unusual year for our country, politically. We have had many Presidential Elections in the past but I dare say none like the one facing us next month. Accusations, promises, and slander at its worst. Our Institute will have an election too but I am confident the victor will not resort to such tactics. This brings me to the point where I must realize that my term of office is about to expire.

It has been a pleasure to serve N.L.G.I. as its President this past year. The honor you bestowed upon me I shall long remember and cherish. Working with the Officers and Directors of our Institute has been a real pleasure and privilege and I want to thank them for the very fine support and cooperation given me.

I particularly want to express my appreciation to the members of the various committees appointed during the year as they all willingly served and carried out their assignments. This sort of support is a great aid to the head of any organization.

Mr. Ted Roehner's contribution as head of our Technical Committee is greater than any of us can imagine. Though I am certain his assignment has required much more time than know about, I do know he has worked hard and ably and in appreciation for his services I want to express the unanimous feeling of gratitude from our Officers and Directors.

May I at this time express my sincere thanks and appreciation for the fine job done by our Program Committee headed by Mr. Wayne Albright. This program and the entertainment to follow is the result of much good work and I am certain you will enjoy it.

In closing, I want to predict continued growth and progress for our Institute in the years to follow.

MEMORIAL ADDRESS FOR

PAST PRESIDENT HOWARD COOPER

delivered at the
20th annual meeting
by
M. R. Bower

MR. PRESIDENT, MEMBERS AND GUESTS — I have been asked to pay tribute to another former director, immediate past President and esteemed friend, Howard Cooper, who passed away Friday, June 27th, at his home in Bronxville, New York. It was here that he resided with his wife, Gertrude, who survives him.

While we knew that Howard had been ill and away from his office, we understood that he was recuperating and although unable to attend the mid-year Directors' Meeting in Hershey in June, his letter addressed to President Merkle sounded encouraging and said he expected to attend the next meeting in September; therefore, it was a great shock to learn of his unexpected death the week following our Hershey meeting.

His quiet and unassuming manner was reflected in a leadership that found many channels through which his ideas could be developed to the point where they became a definite contribution to the advancement of the N.L.G.I

Born in Chicago in 1890, he was graduated from Armour Institute of Technology in 1913 with B. S. and M. E. degrees. After working as a draftsman for nine months, he took his first oil industry job with The Texas Company in 1914, as a lubrication engineer in Chicago.

In November, 1917, during World War I, he was called to Washington as a civilian in the Aviation Section of the Signal Corps in the Lubricants and Fuels Division. Later he entered the field of lubrication engineering and was commissioned a first lieutenant. He had his orders in his pocket waiting to sail overseas when the Armistice was declared.

He was discharged from the Army in December, 1918, and returned to his former job with Texaco in Chicago. After working with them for four years, he decided to make a change.

In November, 1922, he joined Sinclair at its Chicago headquarters as Assistant Chief Lubrication Engineer and when the company moved its home office to New York in 1924, he was transferred there and made Assistant to the Manager of Lubricating Sales. In this capacity he was Assistant to the late Mr. Lloyd P. Lochridge. Along with these duties, Mr. Cooper was given the assignment of Chief Lubrication Engineer.

The government called him to service again in April, 1942, when he became Chief of the Lubricants and Containers Section of the Marketing Division of PAW in Washington, a post which he held until September 1, 1945, when he returned to his former job with Sinclair. He assumed the title of Manager of Technical Service in 1949, which was the position he held at the time of his death.

Howard was associated with the oil industry for thirty-eight years; his technical experience combined with his long background in the marketing of oils and greases naturally stimulated his interest in all N.L.G.I. affairs.

He succeeded Mr. Lockridge as the representative of the Sinclair Refining Company on Board of Directors in 1946. In 1948 he served as Chairman of the Membership Committee and set a new record for members secured. His paper delivered at the annual meeting in 1948 was indeed a contribution toward industry cooperation between the designer and builder of a machine.

In 1950 he served as Vice-President and the following year—1951—he was elected to the Presidency of the N.L.G.I He held membership in a number of societies in addition to N.L.G.I., as follows:

American Petroleum Institute
Society of Automotive Engineers
American Society for Testing Materials
American Society of Mechanical Engineers
American Society of Lubrication Engineers

Howard's passing caused all who knew him to recall his participation and contributions to the N.L.G.I. and those who worked with him appreciated his quick wit, sincerity and ever-courteous manner, which made him a gentleman in the true sense of the word.

The memory of his life will linger as an abiding benediction.

MEMORIAL ADDRESS FOR

PAST PRESIDENT W. H. OLDACRE

delivered at the 20th annual meeting

by

H. P. Hobart

Members, Guests and Friends of the NLGI, your Directors have asked me to present at this Meeting a tribute to the memory of our beloved former Director, associate and friend, William H. Oldacre, to record his long and important association with this Institute for a period of more than 18 years. Mr. Oldacre passed away rather suddenly early this year on Friday, January 18th, at his home in Chicago.

He will long be remembered by his many friends in the Petroleum Industry and especially by his associates in NLGI and those in his own company, for his exceptional understanding, his kindness, his integrity, his high ideals and his love for his family and his friends.

He was one of those fine characters who was always willing to go out of his way to help his fellow man or to share with him his knowledge and understanding. His training and experience embodied Law as well as Engineering and he displayed a remarkable appreciation of the Legal as well as the Mechanical and the Chemical problems with which his active life brought him into contact.

Bill Oldacre, as he was known to his many friends, was born at Warren, Ohio on April 7th, 1892. He was educated at Warren and in 1914 was graduated from Hiram College with the Degree of Bachelor of Arts — Chemistry and later became an honorary member of Pi Tau Sigma National Mechanical Engineering Fraternity. He developed at an early age an unusual interest in basic scientific principles.

Bill's first employment after graduation was with the General Electric Company at Erie, Pennsylvania. He was later with Timken Roller Bearing Company at Canton, Ohio.

Through his work with these organizations and his own keen powers of observation, he soon acquired a real appreciation of the importance of lubrication in this mechanical age and determined to devote his time and energies toward improvements in that field.

Bill joined the D. A. Stuart Company in 1920 as General Superintendent and in 1929 became Director of Research. He advanced to the position of Vice-President in 1929 and to President and General Manager in 1942, which position he held until his death this year. He had served his company for 32 years, during which time he had been extremely active in many Technical Societies and had gained outstanding prominence in this industry generally. His life was replete with worthwhile achievements.

Bill was a recognized authority in the field of metal cutting, on sulphurized and sulpho-chlorinated cutting oils, as well as on many types of lubricating greases.

Bill Oldacre took an active interest in the work of the NLGI back in 1933 and has been very prominent in its affairs. He served on many of its Committees and on the Board of Directors since 1936. On Oct. 28, 1942 he was elected Vice-President and on Nov. 3, 1943 he was elected President of NLGI. Since 1948 he has served as Vice-Chairman of the Technical Committee and during the past year he served on the Membership Committee.

His sound judgment, his unfailing integrity and his readiness to help at all times endeared him to his fellow members and to all with whom he came in contact.

The NLGI and the Petroleum Industry will long owe a great debt of gratitude to Bill Oldacre for the outstanding service which he has rendered.

His many activities on behalf of this industry led him into active participation in a large number of engineering or technical Societies.

In addition to NLGI, these included:

- American Petroleum Institute
- Society of Automotive Engineers
- Coordinating Research Council
- American Society of Mechanical Engineers
- American Society for Testing Materials
- American Chemical Society
- American Society for Metals
- American Society of Tool Engineers
- Association of Iron & Steel Engineers
- American Society of Lubrication Engineers
- Independent Research Comm. on Cutting Fluids

On May 29th, 1917, Bill Oldacre married Florence Harsh, who survives him, with their daughter Katherine Oldacre George and four grandchildren.

Their son, William H. Oldacre, Jr., was killed in the service of his country in France on "D" Day, a loss from which neither Bill nor Florence ever fully recovered.

The four grandchildren include — William H. Oldacre II; also Katherine, Jane and Thomas George.

Bill was indeed a prominent member of our Industry, an outstanding citizen in his community and in our country and a true and esteemed friend of all who had the privilege of knowing him.

One of his closest associates tells me that he has never known a man who had the capabilities that Bill possessed and the sincere desire to impart his knowledge to those with whom he came in contact. His organization respected him to the utmost and will long continue to feel his loss deeply.

His passing creates a void not only in the Industry, but also in the lives of his friends and associates which many of us here will carry to our own passing, when we, with God's Will, may join with him in the life to come.

Technical Committee

Chairman T. G. Roehner, Director of the Technical Service Department, Socony-Vacuum Laboratories

It was the consensus that the Symposium on Utilization of Fatty Acids in the Manufacture of Lubricating Greases, held during the October Annual Meeting of the Technical Committee, was an outstanding success. The symposium was actually a joint activity with the Lubricating Grease Subcommittee of the Market Development Committee of the Fatty Acid Division of Association of American Soap and Glycerine Producers, and it afforded an opportunity for representatives of both industries to present their understanding of mutual problems.

It has been suggested that the symposium's introductory papers be published in the *Spokesman* and also in booklet form. The latter is dependent on the number of requests for copies of the papers. If you are interested in the booklet, write direct to Harry Bennetts at NLGI headquarters. The contents of the papers are indicated by the following titles as taken from the agenda:

"II—SYMPOSIUM ON UTILIZATION OF FATTY ACIDS IN THE MANUFACTURE OF LUBRICATING GREASES ...... Chairman T. E. DeVilliers, Cities Service Oil Company

1. Sources, Manufacture and Composition of Fatty Acids ...... J. M. Kiefer, Armour & Co.
2. Analytical Methods in the Fatty Acid Industry ...... J. L. Trauth, Emery Industries, Inc.
3. Lubricating Grease Characteristics as Influenced by Fatty Acids Composition
   - (a) Calcium Base Greases ...... G. Entwistle, Sinclair Refining Co.
   - (b) Sodium Base Greases ...... L. C. Brunstrum, Standard Oil Co. (Indiana)
   - (c) Aluminum Base Greases ...... W. K. Dean, Mallinckrodt Chemical Works
   - (d) Lithium Soap Greases ...... H. C. Meyer, Foote Mineral Company"

It has been proposed that symposiums or panel discussions be included in future meetings of the Technical Committee. Therefore, a survey will be conducted to investigate that point and to determine which subject may have the widest support for the 1953 Annual Meeting. Several members already have suggested that the subject be:

"Proper Handling of Greases in Service Stations",

or

"Dispensing Greases in Garages and Service Stations — Practices, Right and Wrong"

This subject would recognize the fact that this application is the largest outlet for lubricating greases. There is reason to believe that representatives of car manufacturers would be willing to participate in such a symposium.

Other members have suggested that there would be widespread interest in a discussion of cases where apparent viscosity-shear rate data were used to solve problems beyond the reach of conventional tests.

The aforementioned survey will be started in the near future and all suggestions will receive careful consideration.

Patents and Developments

Complex Aluminum Soap

New aluminum mixed organic anion soaps having unique properties making them particularly useful in lubricating greases, are disclosed in the California Research Corporation U. S. Patent 2,599,533.

The organo anions are derived from organic acids, one of which is relatively oil-soluble and another of which is relatively oil-insoluble. The aluminum di-soaps of the more soluble anions are soluble in an amount of at least 5% at 400° F. in a petroleum white oil of 346 SSU at 100° F. and 54 SSU at 210° F., while the aluminum di-soaps of the less soluble anions are soluble in the latter white oil in an amount of less than 1%. Aluminum benzoate-stearate is an example of a complex aluminum soap covered by the patent.

These soaps are polymeric in structure and can contain as many as 1000 or more monomeric units, each containing one aluminum atom having all of its valencies satisfied by at least one —OH group, and two organo anions. It may be advantageous in some cases to use a complex tri-soap such as aluminum stearate-benzoate-caprylate, also. Suitable oleophilic anions are aliphatic carboxylic acids having 12-18 carbon atoms, aralkyl carboxylic acids, cetyl phenol, etc., while satisfactory oleophobic anions may be benzoic, methyl benzoic, toluic, glutaric, phenylacetic, adipic, pimelic, salicylic and similar acids.

The ration of the oleophilic to the oleophobic anions in the soap can be varied depending on the purpose for which the soap is used. When the soap is used to impart high melting point and resistance to emulsibility in water to the grease composition, the ratio can be altered so that the desired grease structure will be obtained in lubricating oils of varying solvent characteristics. The soaps can be prepared by co-precipitation, or they can be made *in situ* according to the process disclosed in the Jones patent 2,469,041.

Directions are given in the preparation of aluminum azelate-stearate, toluate-stearate, benzoate-stearate, benzoate-12-hydroxystearate, benzoate-naphthenate, benzoate-alkyl benzene sulfonate, benzoate-phosphate-stearate, and alizarinate-stearate. In one example, a mixture, of 12 parts of the complex soap (aluminum benzoate-stearate) were heated at 450° F. with 108 parts of a California solvent-refined paraffinic base oil having a viscosity of 485 SSU at 100° F., and a light brown, translucent grease was obtained having an ASTM dropping point of over 400° F. A 5 gm. sample remained fully intact without any distintegration when immersed in boiling water for 1 hour.

Stabilized Greases Containing Ion-Exchange Resins

It has been the practice to provide free alkalinity in greases to prevent development of free acidity. Antioxidants also are employed.

In its U. S. Patent 2,605,225, Socony-Vacuum Oil Company discloses the incorporation in greases of ion-exchange

resins for this purpose, particularly for high temperature uses. Such resins are of the carboxylic acid type which do not adversely affect the consistency and lubricating properties of the compounded grease.

The patent specified incorporation of 1-10% by weight of an ion-exchange type resin in the form of particles passing, preferably, a 325 mesh screen. Suitable resins for this purpose are Wofatit C, and those disclosed by D'Alelio in U. S. Patent 2,340,111.

Silicone Greases

A homogeneous blend of a liquid organopolysiloxane and a grease-forming thickener, lithium 2-ethylhexoate, is proposed as a lubricating grease in the General Electric U. S. Patent 2,606,153. Such a composition is claimed to possess certain unexpected and unobvious properties in that it is eminently stable at temperatures as high as 225° C. and shows marked improvement in lubricity at elevated temperatures over other greases. Also higher concentrations of the soap may be incorporated in the vehicle, resulting in less breeding, higher dropping points, and greater high temperature resistance.

The organopolysiloxanes (silicones) suitable for such use may be those covered in the Patnode Patent 2,469,888. The soap is preferably added in the concentration of 20-35% of the total weight of the composition. Various balancing ingredients may be added such as polybutene or polyacrylate thickeners, antioxidents, rust inhibitors such as zinc naphthenate, barium mahogany sulfonates or sorbitan monoleate, and anti-wear additives, such as tricresyl phosphate. Data are given on a number of grease compositions.

High Temperature—High Pressure Grease

The lubrication of metal surfaces subjected to repeated or continuous contact with other metal surfaces under pressure of the order of 30,000 psi (which develops temperatures of 300° F.) has posed a difficult problem in lubrication. An example is the lubrication of the rotating cams of the Bucyrus Monighan walking dragline used in strip mining in soft or boggy ground. Such equipment often is used where atmospheric temperatures are as low as —40° F. or lower. The cams of this machine actuate moving pontoons which enable the dragline to "walk", and extremely high pressures are at times developed on the bearing surfaces.

For such conditions, the Standard Oil Company (Indiana) Patent 2,607,732 proposes a lubricant containing 50-95% asphalt, 5-30% lead naphthenate, and 1-20% of an olefin polymer of 500-25,000 molecular weight, the monomer preferably having 3 - 4 carbon atoms. To facilitate application, the lubricant can contain a diluent which is volatilized at above 150° F.

The asphalt preferably has an ASTM penetration of 15 - 110 under a load of 5 gm. for 5 sec. at 770° F., and an ASTM ring and ball softening point of 110° - 260° F.

In U. S. Patent 2,607,733, the mixture contains 7 - 12% lead naphthenate, 10 - 15% chlorinated hydrocarbon diluent (trichloro-ethylene), and the remainder asphalt. Such a lubricant has a Saboltfurol viscosity at 210° F. of 65 - 85.

News Items

Aluminum stearates having a high ratio of aluminum to stearic acid were exhibited by workers of Battelle Memorial Institute and Aluminum Co. of America (N. Y. J. Commerce 9/10/52).

PEOPLE in the Industry

Bruner Becomes Battenfeld's Executive Vice-President

Hugh H. Bruner, 5716 Birch, Mission, Kansas, was elected Executive Vice-President of the Battenfeld Grease and Oil Corporation at the November meeting of the Board of Directors. Bruner has served the Corporation since 1948 as Treasurer, Comptroller, and as a Director. As Executive Vice-President, he will work with all departments of the firm. Battenfeld is located at 3148 Roanoke Road, Kansas City 8, Missouri.

Bruner was graduated from the University of Kansas in 1941. He saw combat in World War II as a Captain of Infantry in Europe. After his release from active duty, he returned to public accounting in Kansas City before joining Battenfeld.

He is a member of the Trinity Lutheran Church, the Chamber of Commerce of Kansas City, the Rotary Club of Kansas City, Disabled American Veterans, the National Association of Cost Accountants, and is active in the Boy Scouts of America. He is married and has three children.

Bond Becomes Alemite's Sales Promotion Manager

Chicago — George B. Bond has been appointed to the newly created position of sales promotion manager of the Alemite lubrication equipment and Stewart-Warner Instrument division of Stewart-Warner Corporation, F. A. Hiter, senior vice-president of Stewart-Warner and head of Division One of the company, has announced. Bond assumed his new duties September 15.

Bond's duties will include the coordination of advertising programs with sales programs, and the creation of merchandising campaigns, presentations and materials for distributors and jobbers in the automotive, farm and industrial markets, Mr. Hiter said. He will report directly to Mr. Hiter.

Bond was advertising manager of the Sears retail store in Gary, Ind., advertising manager of Arnold, Schwinn & Co., bicycle manufacturers, and account executive for the Bozell & Jacobs advertising agency prior to joining Stewart-Warner. Born in Newark, N. J., and raised in Wheaton, Ill., he attended Purdue University and the University of Illinois, earning a B.S. in commerce. He is a member of the Chicago Federated Advertising Club and the Artists' Guild of Chicago.

Whittemore Appointed Vice-President of Warwick Chemical

Mr. Harold C. Whittemore, Jr., has been appointed Vice President of the Warwick Chemical Company, Division Sun Chemical Corporation, it was announced today by Mr. George W. Ullman, President of Sun Chemical.

LUBRICATE FOR SAFETY
EVERY 1000 MILES

"--THE MANUFACTURER MUST HAVE BEEN RIGHT--HE SAID LUBRICATE EVERY 4,000 MILES---THIS HAPPENED AT 4,003!"

Mr. Whittemore joined Sun Chemical in 1946 and served five years with Sun in Chicago where he was associated with various activities in the midwest. His most recent position has been Assistant to the President at Sun's headquarters in New York City.

In his new capacity, Mr. Whittemore's headquarters will be at the Wood River Junction, Rhode Island, plant. Mr. Donald J. Eccleston and Mrs. Ira S. Hurd will continue as general manager and general sales manager respectively under Mr. Whittemore.

Warwick Chemical is a leading manufacturer of textile chemicals and auxiliaries, detergents, textile and plastic printing colors and stearates, with plants located in Wood River Junction, Rhode Island, Rock Hill, South Carolina, Harrison, New Jersey, and North Bergen, New Jersey.

Mr. Whittemore, a graduate chemist of Columbia University also studied petroleum refining engineering at Texas A and M College. During World War II, he served as fighter pilot with the rank of Captain in the U. S. Marine Corps, in the Pacific area.

THE N.L.G.I GUIDE POST

Industry CROSSROADS FOR BUYERS and SELLERS

SUPPLIERS OF MATERIALS FOR MANUFACTURING LUBRICATING GREASES

Industry NEWS

API Division of Refining Plans Mid-Year Meeting

New York—The Division of Refining of the American Petroleum Institute is planning a full program of technical sessions for its Mid-year Meeting in New York next May 11-14, John W. Newton, API Vice President for the Division of Refining, announced recently.

He reported that the Program Committee, under the chairmanship of W. M. Holaday, of Socony-Vacuum Oil Co., New York, has received sufficient offers of papers to justify the setting up of technical sessions on nine major subjects.

Newton, who is vice president and general manager of Magnolia Petroleum Co., Beaumont, Tex., said committees have been designated to handle offers of papers and other details connected with the individual sessions. Chairmen of the committees are as follows:

Analytical Research: E. L. Baldeschwieler, Standard Oil Development Co., P. O. Box 51, Linden, N. J.

Deterioration of Metals: N. J. Rees, Socony-Vacuum Oil Co., Inc., 26 Broadway, New York, N. Y.

Electrical Equipment: L. M. Goldsmith, The Atlantic Refining Co., 260 South Broad St., Philadelphia, Pa.

Corrosion of Refinery Equipment: E. Q. Camp, Humble Oil & Refining Co., P. O. Box 3538, Houston, Tex.

Refinery Waste Disposal: R. N. Giles, Standard Oil Company (Indiana), 910 South Michigan, Chicago, Ill.

Motor Fuels: J. Bennett Hill, Sun Oil Co., Marcus Hook, Pa.

Personnel Training: A. E. Houseknecht, Esso Standard Oil Co., 15 West 51st St., New York, N. Y.

Lubricating Oils: J. C. Geniesse, The Atlantic Refining Co., 3144 Passyunk Ave., Philadelphia, Pa.

Processes: F. W. Schumacher, Standard Oil Development Co., P. O. Box 121, Linden, N. J.

Newton announced that anyone desiring to offer papers on any of these topics should communicate with the committee chairman, or with W. T. Gunn, Director, Division of Refining, American Petroleum Institute, 50 West 50th Street, New York 20, N. Y.

These offers, he continued, should be submitted promptly with a brief general description of the contents of the paper. Each will receive immediate consideration. If accepted, manuscripts must be submitted by next Feb. 1 to allow time for editorial service and pre-printing.

Newton also announced that C. M. Ridgway, of The Pure Oil Co., Crystal Lake, Ill., has been appointed chairman of the Program Committee for 1953.

LUBRICATE FOR SAFETY
EVERY 1000 MILES

"PROPER LUBRICATION MIGHT HAVE PREVENTED THE CAR FROM GOING TO THE LEFT WHEN YOU TURNED THE WHEEL TO THE RIGHT!"

Silent Sound Being Harnessed

Chicago, Ill. — Silent sound — silent only because it is pitched so high or so low that the human ear fails to register it—is being harnessed to do many fantastic things such as drilling wells, pumping oil, peering through metals and treating aches and pains, according to an article in the December issue of Popular Mechanics Magazine.

The human ear detects only sound waves that vibrate from about 20 to some 20,000 cycles per second. Vibrations above that band are ultrasonic; those below are infrasonic. Both are being put to work.

Ultrasound is being used to look inside castings and forgings as easily as if they were made of ice. The same high-frequency vibrations are being used by physicians to treat patients who are suffering from diseases of the joints.

Infrasound, on the other hand, has been found to be useful in heavy work. It is packing loose sand into hard roads that can support heavy truck traffic. It is also drilling oil wells and then pumping the oil above ground more efficiently.

Recently, at Ventura, California, petroleum engineers watched a sonic drill that may revolutionize the science of drilling for oil. The "Soundrill", which stems from research by Alfred G. Bodine of Los Angeles, uses infrasonic energy to fatigue and break up the formation ahead of the drilling bit. Sound waves do the work more cheaply, produce straighter holes and eliminate most of the tedious "round trips" necessary to replace a worn or damaged bit, the article states.

These low frequency waves also hold the promise of doubling the amount of oil that can be extracted from the ground. Present methods extract no more than 25 to 35 per cent of the oil from a petroleum deposit. Today it appears that infrasonic energy can be used to vibrate the formations, or heat them up, to release once again as much oil as we have been getting.

"The sonic pump in its present form vibrates the surrounding rock to some extent and unclogs it, enabling more oil to flow," Mr. Bodine says. "Now we are designing new pumps that will transmit some of their energy into the formation at the same time they do the pumping job. Experiments with cores of oil sands indicate we can about double the total production of oil from any deposit."

Meanwhile, at the upper end of the sound spectrum equally spectacular things are going on, according to the Popular Mechanics article. Tiny ultrasonic drills are being used by jewelers to drill square holes, or holes of any shape desired, through metals, ceramics, or even precious stones. Ultrasound is used in hastening some chemical processes, in degreasing and in other jobs in which vibrations are helpful.

Ultrasonic washing machines vibrate dirt particles from clothes, doing a better job than conventional machines. High-frequency waves in the audible range trap smoke particles, reducing the soot and dirt that escape from industrial plants.

But the two fields in which ultrasonics are perhaps most important are in treating painful diseases of the joints (such as arthritis), neuralgic conditions and other ills and in the inspection of metals for interior flaws. Ultrasonic inspection of metals is faster and simpler than X-ray inspection and can penetrate to depths far beyond the scope of X-ray machines.

FUTURE MEETINGS of The Industry

JANUARY, 1953

7-8 Kentucky Petroleum Marketers Assn. (annual meeting — trade show), Brown Hotel, Louisville, Ky.

12-16 Socy. of Automotive Engineers (annual meeting and engineering display), Sheraton-Cadillac Hotel, Detroit, Mich.

FEBRUARY, 1953

1-6 American Socy. for Testing Materials (Com. D-2 on petroleum products and lubricants), Hotel Cleveland, Cleveland, O.

3-5 American Socy. for Testing Materials (A-1 on Steel), Birmingham, Ala.

5-7 Missouri Petroleum Assn. (annual convention), Hotel President, Kansas City, Mo.

13 American Socy. for Testing Materials (Philadelphia District — National Officer's Night), Philadelphia, Pa.

16-18 American Petroleum Institute (Division of Marketing, Lubrication Committee meeting), Sheraton-Cadillac, Detroit, Mich.

18-19 Iowa Independent Oil Jobbers Assn. (annual convention), The Savery, Des Moines, Ia.

25-26 Wisconsin Petroleum Association, Hotel Schroeder, Milwaukee, Wisc.

26 to Mar. 1 Pacific Automotive Show, Civic Auditorium, San Francisco, Calif.

MARCH, 1953

2-6 American Socy. for Testing Materials (spring meeting), Hotel Statler, Detroit, Mich.

4-6 American Petroleum Institute (Division of Production, Southwestern district), The Blackstone, Ft. Worth, Tex.

8-11 American Inst. of Chemical Engineers, The Buena Vista, Biloxi, Miss.

10-12 Illinois Petroleum Marketers Assn. (annual convention), Hotel Sherman, Chicago, Ill.

15-19 American Chemical Society (123rd national meeting), Hotels Biltmore and Statler, Los Angeles, Calif.

FUTURE MEETINGS

MARCH, 1953

16-20 National Assn. of Corrosion Engineers (1953 conference and exhibition), Hotel Sherman, Chicago, Ill.

18-20 American Petroleum Institute (Division of Production, Mid-Continent District spring meeting), Mayo Hotel, Tulsa, Okla.

19-21 Texas Oil Jobbers Assn. Inc. (annual convention), The Plaza Hotel, San Antonio, Tex.

23-26 American Assn. of Petroleum Geologists—Socy. of Economics Paleontologists and Mineralogists —Socy. of Exploration Geophysicists (joint annual meeting), Coliseum, Houston, Tex.

25-27 Socy. of Automotive Engineers (national production meeting), Hotel Statler, Cleveland, Ohio.

APRIL, 1953

8-10 American Petroleum Institute (Division of Production, Eastern District spring meeting), Hotel William Penn, Pittsburgh, Pa.

13-15 American Socy. of Lubrication Engineers (annual meeting and exhibit), Hotel Statler, Boston, Mass.

13-15 Assn. of Nebraska Liquefied Petroleum Gas Dealers (annual convention), Hotel Fontenelle, Omaha, Neb.

15-17 National Petroleum Association (semi-annual meeting), Hotel Cleveland, Cleveland, Ohio.

20-22 American Petroleum Institute (Division of Transportation, products pipeline conference), Hotel Muehlebach, Kansas City, Mo.

26-29 American Inst. of Chemical Engineers (joint meeting with Chemical Institute of Canada), Royal York Hotel, Toronto, Canada.

27-28 Independent Petroleum Assn. of America (midyear meeting), Jefferson Hotel, St. Louis, Mo.

MAY, 1953

4-5 American Petroleum Institute (Division of Marketing, midyear meeting), Baker Hotel, Dallas, Tex.

4-6 Liquefied Petroleum Gas. Assn. (annual convention & trade show), Conrad Hilton Hotel, Chicago, Ill.

10-12 tentative Pennsylvania Petroleum Assn., Inc. (3-day meeting), Bedford Springs Hotel, Bedford Springs, Pa.

11-13 American Petroleum Institute (Division of Marketing, Lubrication Committee meeting), Greenbrier, White Sulphur Springs, West Va.

FUTURE MEETINGS

MAY, 1953

11-14 American Petroleum Institute (Division of Refining, 18th midyear meeting), Hotel Commodore, New York, N. Y.

11-15 National Fire Protection Assn. (annual meeting), Edgewater Beach Hotel, Chicago, Ill.

14-23 International Petroleum Exposition, Tulsa, Okla.

16-18 National Petroleum Assn. (51st annual meeting), The Traymore, Atlantic City, N. J.

21-23 American Trade Assn. Executives (annual meeting), Chalfonte-Haddon Hall, Atlantic City, N. J.

JUNE, 1953

2-3 American Petroleum Institute (Division of Production, Pacific Coast District spring meeting), Hotel Statler, Los Angeles, Calif.

7-12 Socy. of Automotive Engineers (summer meeting), The Ambassador and Ritz-Carlton, Atlantic City, N. J.

15-19 American Petroleum Institute (Division of Production, midyear committee conference), Hotel William Penn, Pittsburgh, Pa.

29 to July 3 American Socy. for Testing Materials (annual meeting), Chalfonte-Haddon Hall, Atlantic City, N. J.

AUGUST, 1953

17-19 Socy. of Automotive Engineers (national West Coast meeting), Georgia Hotel, Vancouver, B. C., Canada.

SEPTEMBER, 1953

6-11 American Chemical Society (124th national meeting), Conrad Hilton Hotel, Chicago, Ill.

13-16 American Inst. of Chemical Engineers, Fairmont and Mark Hopkins Hotels, San Francisco, Calif.

16 American Petroleum Institute (Division of Marketing, Lubrication Committee meeting), The Traymore, Atlantic City, N. J.

OCTOBER, 1953

19-20 Independent Petroleum Assn. of America (annual meeting), Hotel Texas, Ft. Worth, Tex.

19-23 National Safety Congress, Conrad Hilton, Congress, Morrison, Sheraton, Chicago, Ill.

26-28 National Lubricating Grease Institute, Annual Meeting, Edgewater Beach Hotel, Chicago, Illinois.

NOVEMBER, 1953

9-12 American Petroleum Institute (33rd annual meeting), Conrad Hilton Hotel and Palmer House, Chicago, Ill.

2-4 Socy. of Automotive Engineers (national transportation meeting), Conrad Hilton Hotel, Chicago, Ill.

3-4 Socy. of Automotive Engineers (national diesel engine meeting), Conrad Hilton Hotel, Chicago, Ill.

5-6 Socy. of Automotive Engineers (national fuels and lubricants meeting), Conrad Hilton Hotel, Chicago, Ill.

30 to Dec. 5th. 24th Exposition of Chemical Industries, Grand Central Palace, New York, N. Y.

DECEMBER, 1953

13-16 American Inst. of Chemical Engineers (annual meeting), Hotel Jefferson, St. Louis, Mo.

N. L. G. I. Associate & Technical Members....

Supporting Your Organization These Suppliers of Your Industry Hold Membership in the N.L.G.I.

SUPPLIERS OF MATERIALS FOR MANUFACTURING LUBRICATING GREASES

American Cyanamid Company
30 Rockefeller Plaza
New York City 20, New York
Representative—W. D. Thomas, Jr.

Archer-Daniels-Midland Company
Chemical Products Division
2191 West 110th Street
Cleveland 2, Ohio
Representative—Frank C. Haas

Armour & Co., Chemical Division
1355 West 31st St.
Chicago 9, Illinois
Representative—Dale V. Stingley

Darling & Company
4201 South Ashland Avenue
Chicago 9, Illinois
Representative—G. W. Trainor

E. I. du Pont de Nemours and Company
Wilmington, Delaware
Representative—John R. Sabina

Emery Industries, Inc.
4300 Carew Tower
Cincinnati 8, Ohio
Representative—R. F. Brown

Enjay Company, Inc.
15 West 51st Street
New York 19, New York
Representative—Sidney W. Fay

Foote Mineral Company
18 West Chelten Avenue
Philadelphia 44, Pennsylvania
Representative—H. C. Meyer, Jr.

General Mills, Inc.
Chemical Division
400 Second Avenue South
Minneapolis 1, Minnesota
Representative—Sewall D. Andrews

A. Gross and Company
295 Madison Avenue
New York 17, New York
Representative—Eugene W. Adams

W. C. Hardesty Company, Inc.
P. O. Drawer 110
Dover, Ohio
Representative—W. G. McLeod

Harshaw Chemical Company
1945 East 97th Street
Cleveland 6, Ohio
Representative—W. J. Straka

Leffingwell Chemical Company
P. O. Box 191
Whittier, California
Representative—D. E. Murphy

The Lubrizol Corporation
Euclid Station
Box 3057
Cleveland 17, Ohio
Representative—John H. Baird

Mallinckrodt Chemical Works
2nd and Mallinckrodt Streets
St. Louis 7, Missouri
Representative—C. E. Cosby

N. I. Malmstrom & Company
147 Lombardy Street
Brooklyn 22, New York
Representative—Ivar Wm. Malmstrom

Marcus Ruth Jerome Company
327 South LaSalle Street
Chicago 4, Illinois
Representative—Harry Bernstein

Metalloy Corporation
Division of Lithium Corporation of America
Rand Tower
Minneapolis 2, Minnesota
Representative—Walter M. Fenton

Metasap Chemical Corporation
Harrison, New Jersey
Representative—O. E. Lohrke

Monsanto Chemical Company
1700 Second Street
St. Louis 4, Missouri
Representative—J. W. Newcombe

National Lead Company
Baroid Sales Division
111 Broadway
New York 5, New York
Representative—Alex Stewart

National Rosin Oil Products, Inc.
1270 Avenue of the Americas
New York City 20, New York
Representative—Richard Bender

M. W. Parsons—Plymouth, Inc.
59 Beekman Street
New York City 38, New York
Representative—Herbert Bye

Synthetic Products Company
1636 Wayside Road
Cleveland 12, Ohio
Representative—Garry B. Curtiss

Swift & Company
165th & Indianapolis Boulevard
Hammond, Indiana
Representative—F. H. Beneker

Vegetable Oil Products Company, Inc.
Vopcolene Division
5568 East 61st Street
Los Angeles 22, California
Representative—C. F. Williams

Warwick Chemical Company
Division Sun Chemical Corporation
10-10 44th Avenue
Long Island City 1, New York
Representative—Dr. J. J. Whitfield

Witco Chemical Company
75 East Wacker Drive
Chicago 1, Illinois
Representative—E. F. Wagner

CONTAINER AND CLOSURE MANUFACTURERS

Central Can Company
2415 West 19th Street
Chicago 8, Illinois
Representative—Henry Frazin

Continental Can Company, Inc.
1107 Waldheim Building
Kansas City 6, Missouri
Representative—T. A. Graham

Geuder, Paeschke & Frey Company
324 North Fifteenth Street
Milwaukee 1, Wisconsin
Representative—Willard J. Flint

Inland Steel Container Company
6532 South Menard Avenue
Chicago 38, Illinois
Representative—John H. Strome

J. & L. Steel Corp.
(Container Division)
405 Lexington Avenue
New York 17, New York
Representative—Jerry Lyons

National Steel Container Corporation
6700 South LeClaire Avenue
Chicago 38, Illinois
Representative—Henry Rudy

The Ohio Corrugating Co.
917 Roanoke Ave. S. E.
Warren, Ohio
Representative—Lawrence F. McKay

Rheem Manufacturing Company
570 Lexington Avenue
New York 22, New York
Representative—G. Wesley Gates

Rieke Metal Products Corporation
Auburn, Indiana
Representative—Ralph S. Pearson

United States Steel Products
Division United States Steel Company
30 Rockefeller Plaza
New York City 20, New York
Representative—Wm. I. Hanrahan

Vulcan Stamping & Manufacturing Co.
P. O. Box 367
Bellwood, Illinois
Representative—H. B. Scharbach

MANUFACTURERS OF EQUIPMENT FOR APPLICATION OF LUBRICATING GREASES

Aro Equipment Corporation
Byron, Ohio
Representative—R. W. Morrison

Balcrank, Inc.
Disney near Marburg
Cincinnati 9, Ohio
Representative—Richard P. Field

Gray Company, Inc.
60 Northeast 11th Avenue
Minneapolis 13, Minnesota
Representative—B. A. Beaver

Lincoln Engineering Company
5701 Natural Bridge Avenue
St. Louis 20, Missouri
Representative—G. A. Hubbard

Stewart-Warner Corporation
Alemite Division
1826 Diversey Parkway
Chicago 14, Illinois
Representative—Walter Duncan

United States Air Compressor Company
5300 Harvard Avenue
Cleveland 5, Ohio
Representative—C. A. Bening

SUPPLIERS OF EQUIPMENT FOR MANUFACTURING LUBRICATING GREASES

Buflovak Equipment Division of Blaw-Knox Company
1543 Fillmore Avenue
Buffalo 11, New York
Representative—Edward V. Hegg

Chemicolloid Laboratories, Inc.
30 Church Street
New York 7, New York
Representative—David F. O'Keefe

The Girdler Corporation
224 East Broadway
Louisville 1, Kentucky
Representative—J. E. Slaughter, Jr.

Morehouse Industries
707 Henry Grady Building
Atlanta 3, Georgia
Representative—George E. Missbach

Stratford Engineering Corporation
1414 Dierks Building
Kansas City 6, Missouri
Representative—J. W. Sylvester

REFINERS

Farmers Union Central Exchange, Incorporated
P. O. Box G
St. Paul 1, Minnesota
Representative—H. F. Wagner

Freedom Valvoline Oil Company
Box G
Freedom, Pennsylvania
Representative—D. A. Smith

Mid-Continent Petroleum Corporation
Mid-Continent Building
P. O. Box 381
Tulsa, Oklahoma
Representative—J. W. Basore

TECHNICAL AND RESEARCH ORGANIZATIONS

Midwest Research Institute
4049 Pennsylvania
Kansas City 2, Missouri
Representative—Dr. M. H. Thornton

Petroleum Educational Institute
9020 Melrose Avenue
Los Angeles 46, California
Representative—G. A. Zamboni

Phoenix Chemical Laboratory, Inc.
3953 W. Shakespeare Avenue
Chicago 47, Illinois
Representative—Mrs. G. A. Krawetz

Sociedade Nacional de Petroleos
Rua D. Pedro V, no. 80
Lisbon, Portugal
Representative—Manuel Corda Boullosa